PICO-NARE: Measurements at 2225 m on the summit caldera of Pico mountain, Pico Island, Azores, Portugal

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MichiganTech

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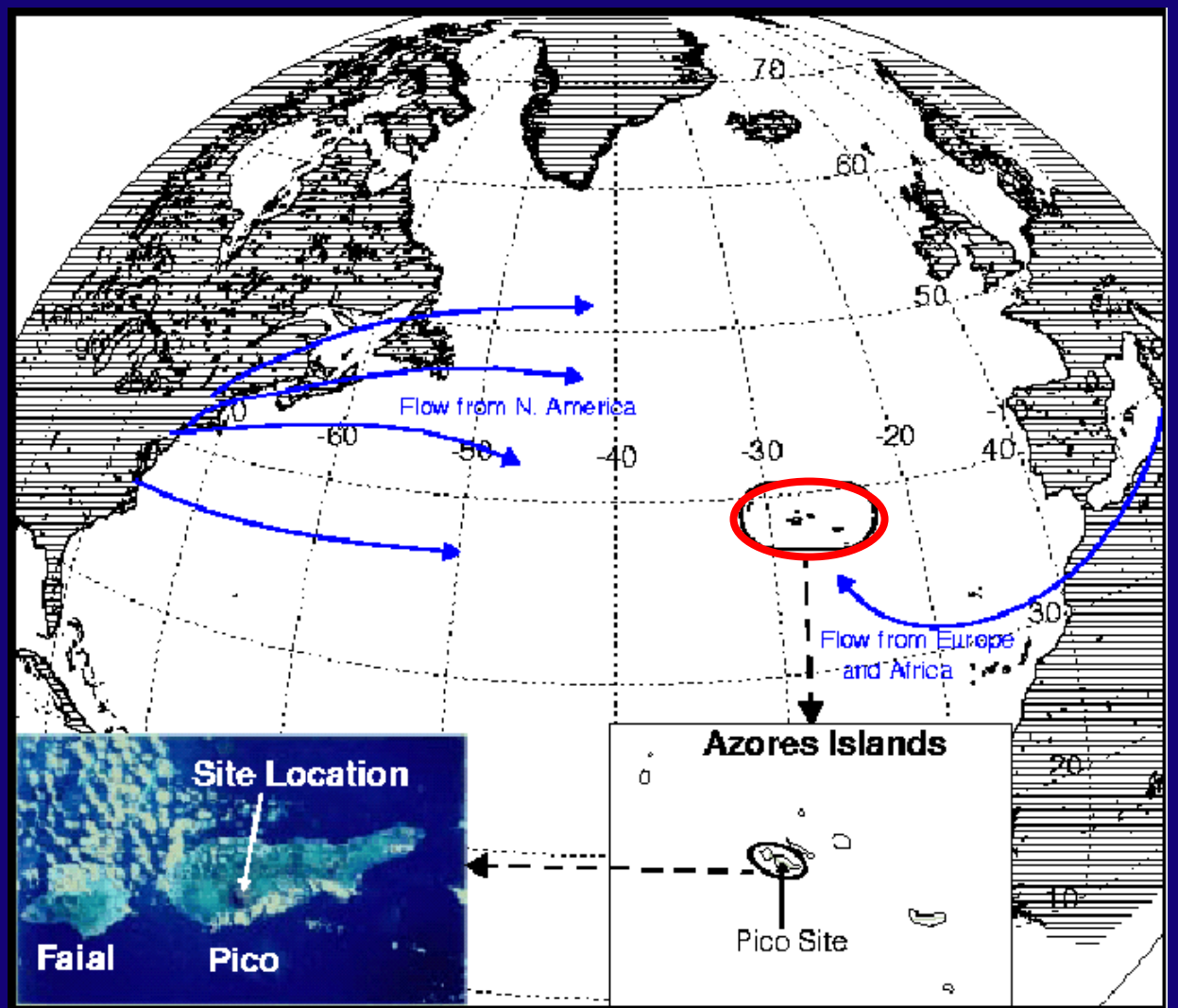
Measurement Location

- Goal: Continuous sampling in central N. Atlantic FT (with occasional MBL upflow).



View at beginning of a 2004 event

View during event

Closeup of the station

Current Measurements

- CO (7/2001 -)
- O3 (7/2001 -)
- Black carbon (aethalometer) (7/2001 -)
- NO, NO2, NOy (7/2002 -)
- NMHCs (in-situ GC and cartridge sampler) (7/2004 -)
- Met (wind, temp, RH, JNO2)

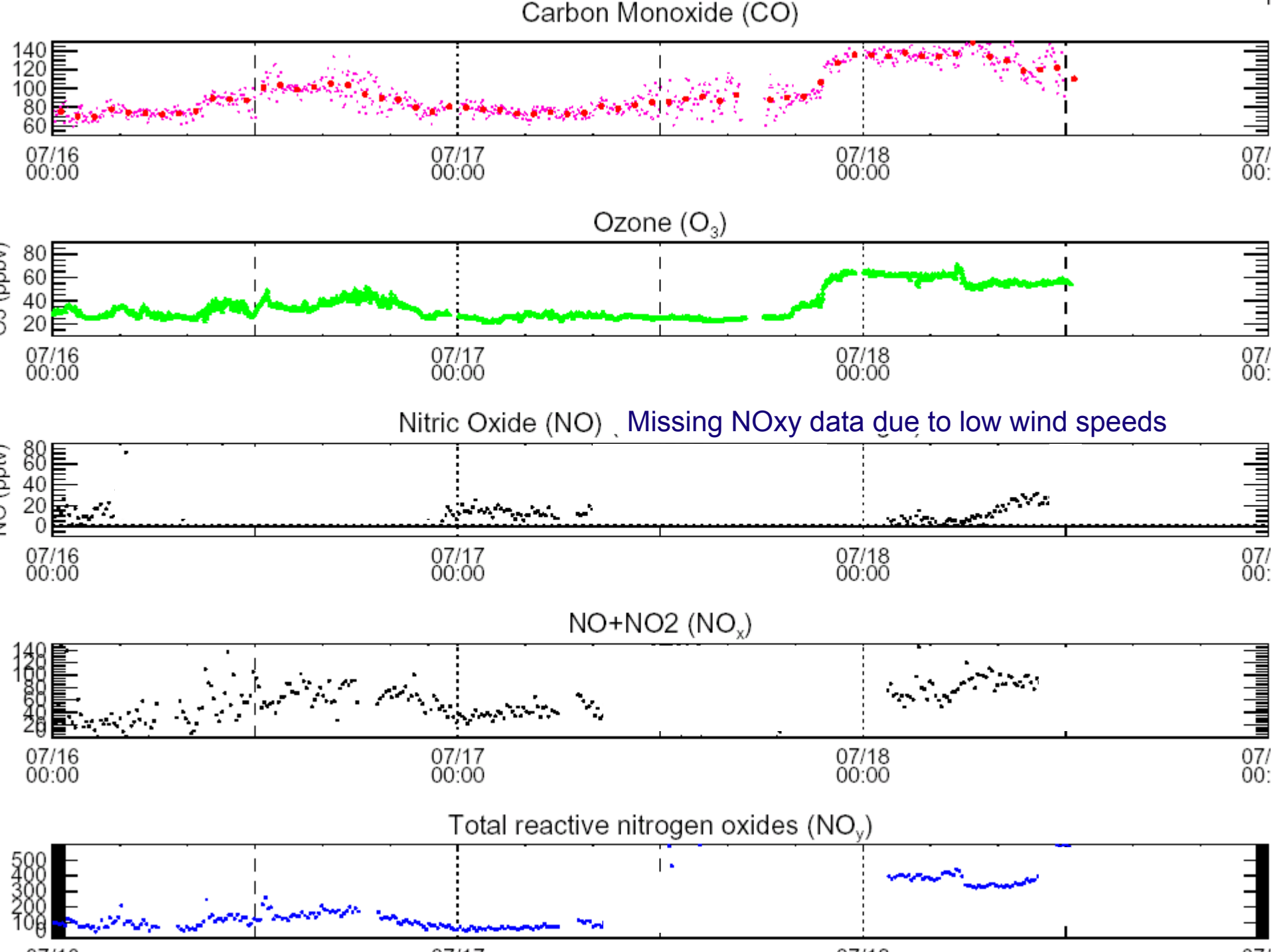
Mountainside Met (summer 2004)

- Purpose: Characterize upslope/downslope flow.
- Two 3-m towers (wind, T, RH)
- One 10-m tower (wind, turbulence, T, RH)
- Four wireless temperature sensors (“motes”)

ICARTT Intensive Activities

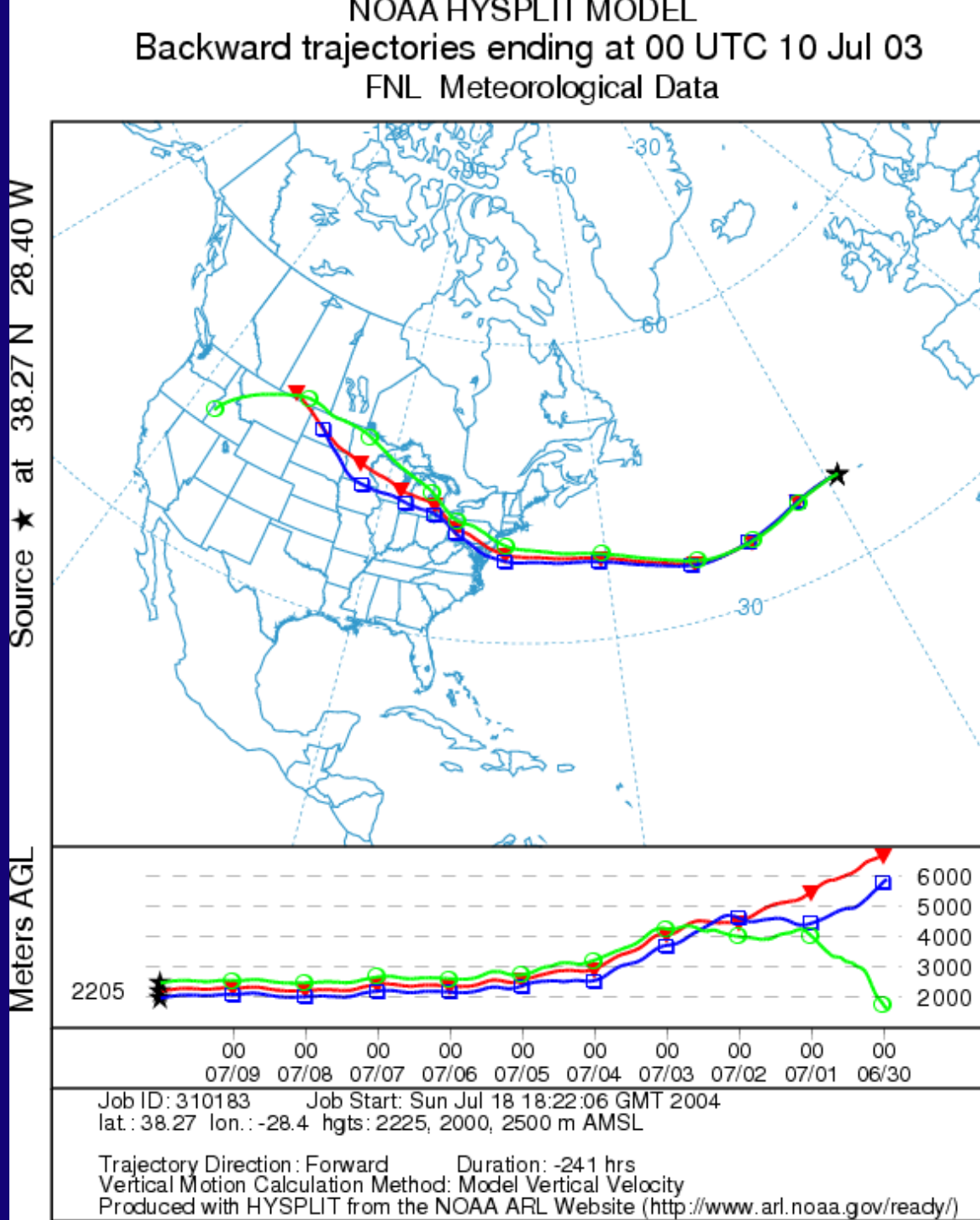
- Nearly continuous measurements during WP-3/DC-8 period+~4 days.
- Coordination with British Bae-146 flights; race track profiles near Pico at the end of each flight for intercomparison and to characterize MBL/FT boundary near the mountain.

  (First such flight 7/17; Data not yet compared.)


Carbon Monoxide (CO)
140
120
100
80
60
07/16 00:00
07/17 00:00
07/18 00:00
Ozone (O_3)
80
60
40
20
Nitric Oxide (NO)
Missing NOxy data due to low wind speeds
80
60
40
20
0
NO+NO2 (NO_x)
140
120
100
80
60
40
20
Total reactive nitrogen oxides (NO_y)
500
400
300
200
100
0

Transport patterns during a typical lower FT U.S. outflow event hitting the Azores 7/10/2003 00 UTC

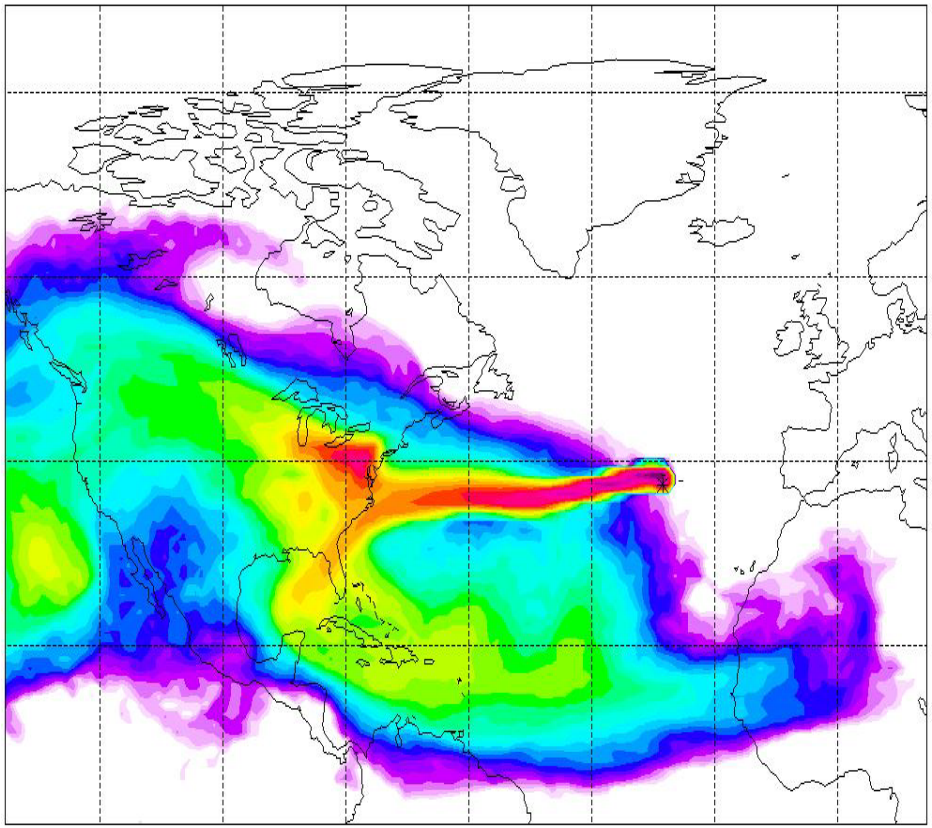
1. Backward trajectories



Column-integrated S-R-Relationship for measurement point 2

Actual time 20030620. 0 End time of sampling 30000

2a. HYSPLIT residence time



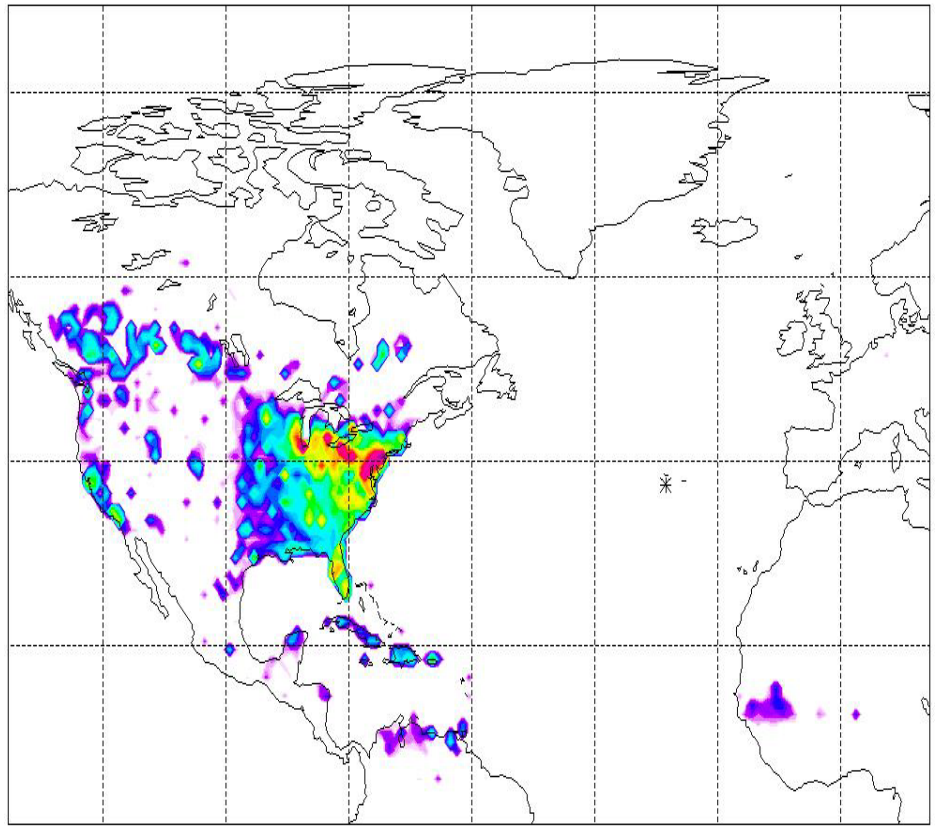
0.0 0.2 0.4 0.8 1.6 3.1 6.2 12.5 25.0 50.0 100.0

Maximum value 0.122E+05 seconds

Column-integrated S-R-Relationship for measurement point 2

Actual time 20030620. 0 End time of sampling 30000

2b. HYSPLIT Footprint (res time x emissions)



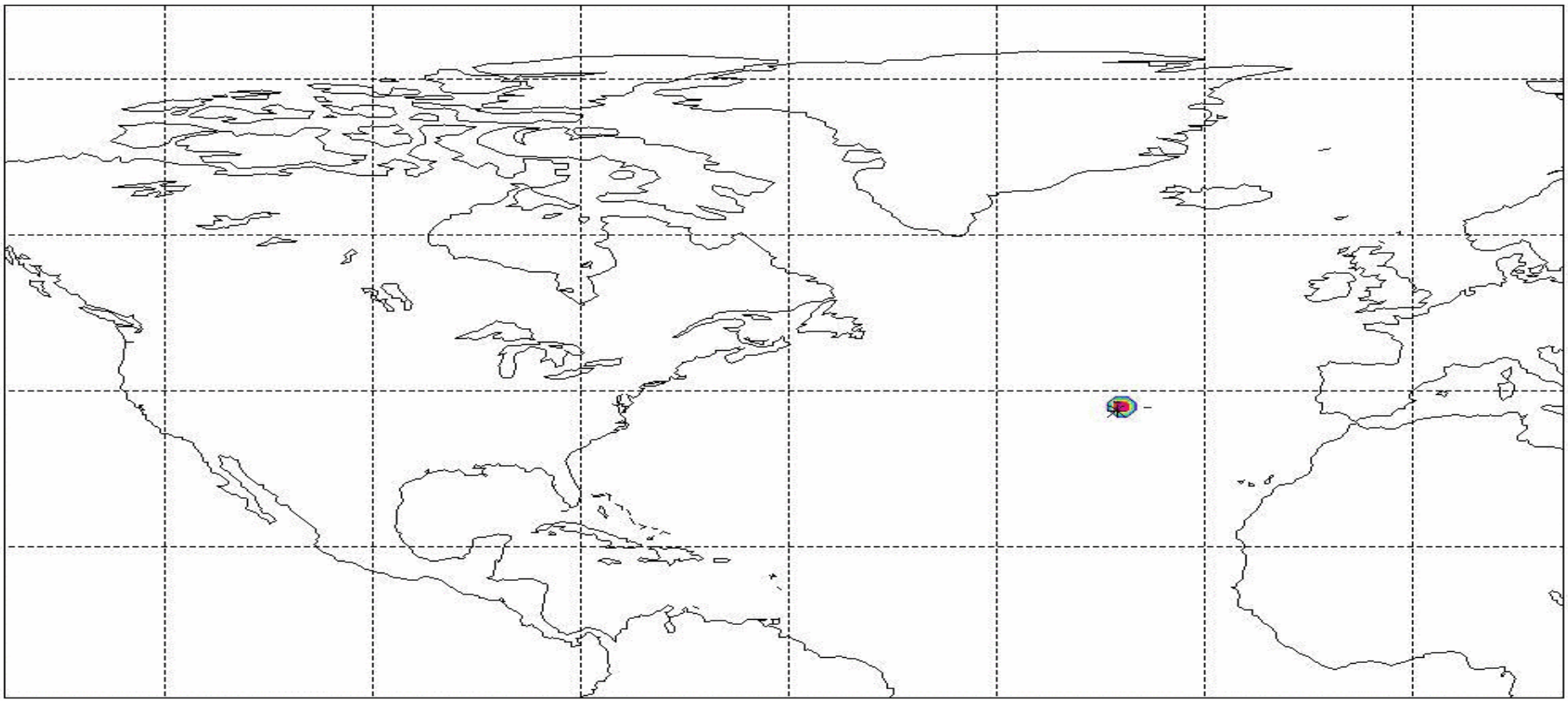
0.000 0.119 0.239 0.478 0.956 1.912 3.824 7.648 ***** ***** *****

ppbv per grid cell

Column-integrated S-R-Relationship for measurement point 2

Actual time 20030710. 0 End time of sampling 30000

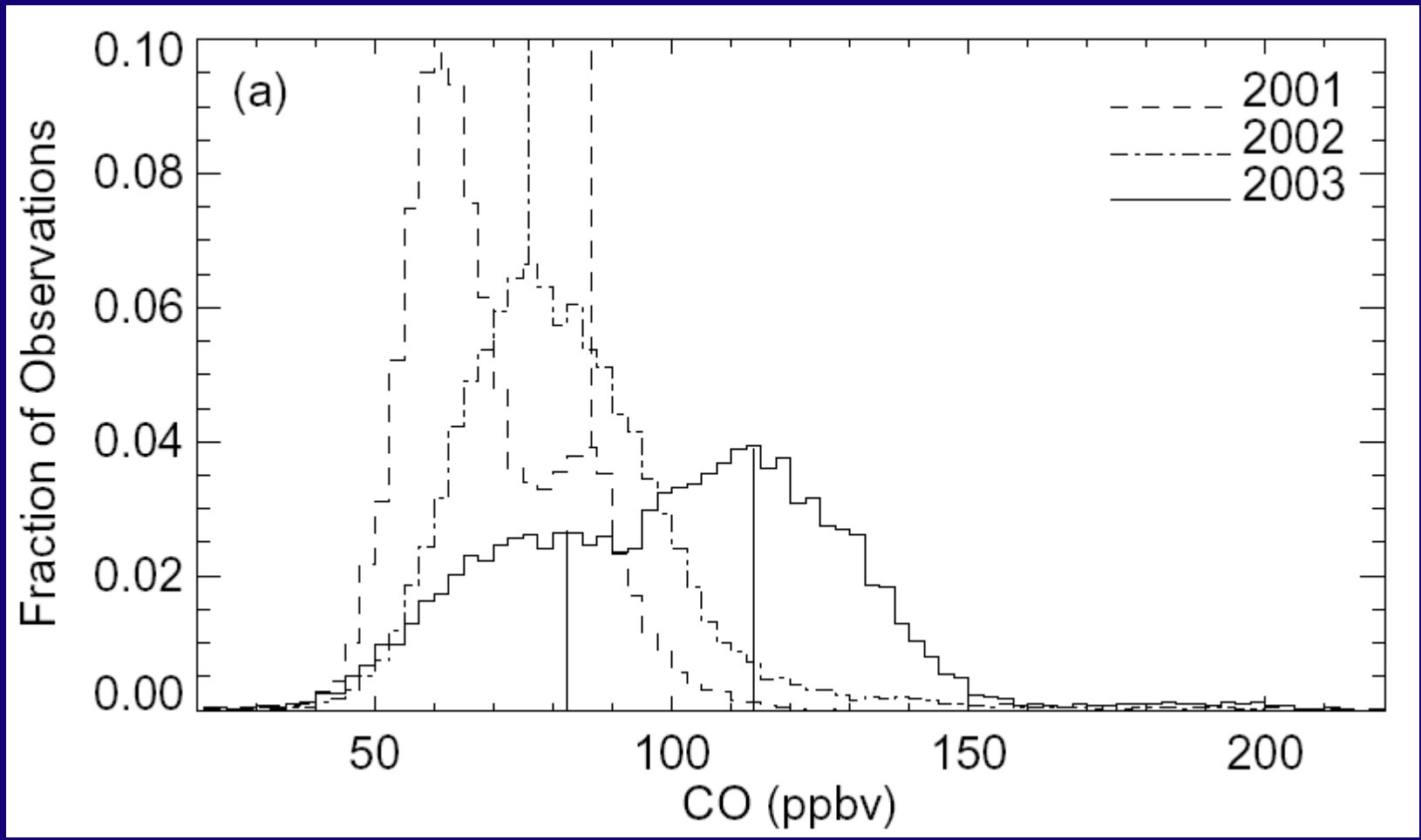
3. HYSPLIT retro plume



Maximum value 0.342E+04 s m3 / kg

Results from summers 2001-2003

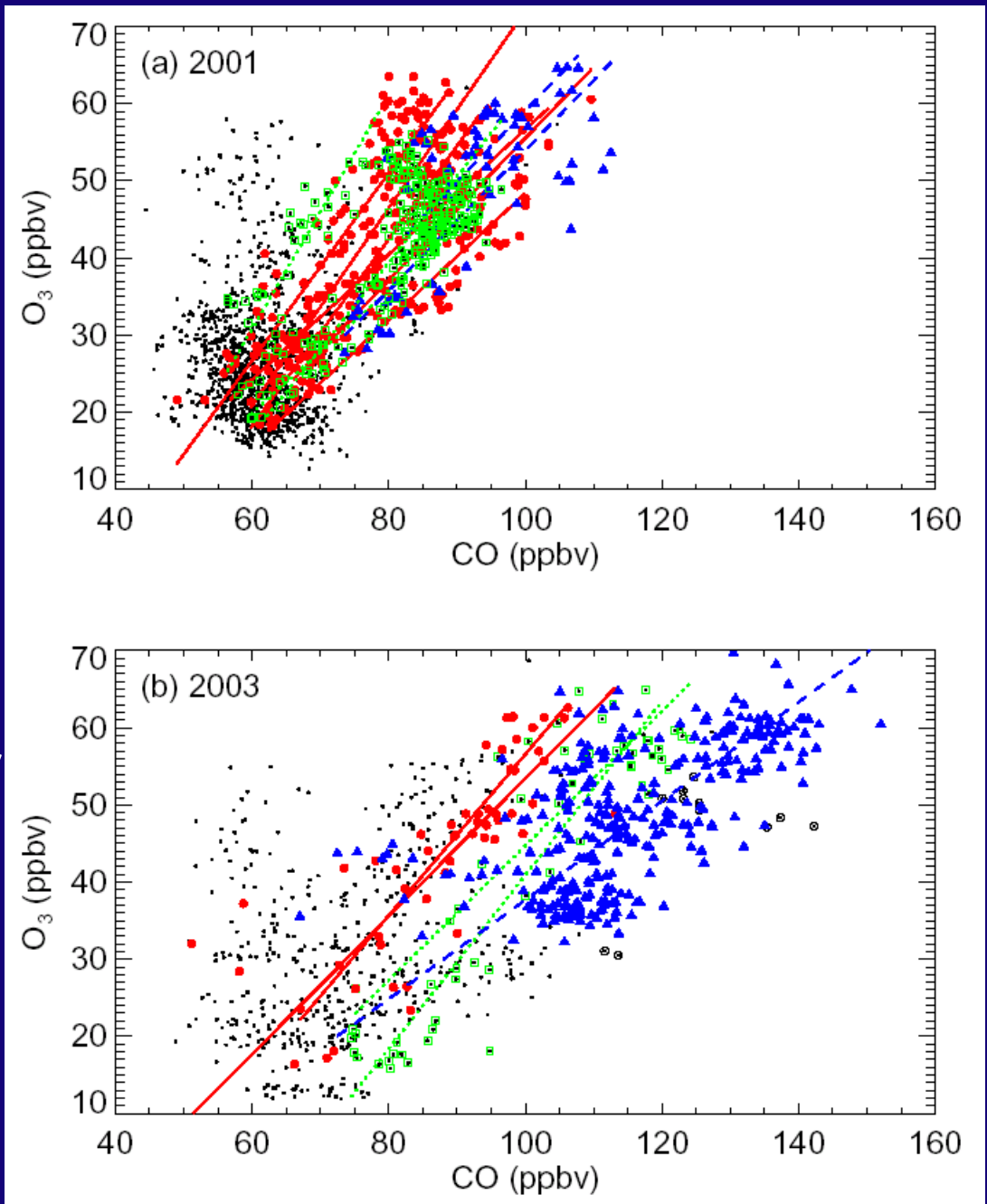
- Large degree of interannual variability in [CO].
- Attributed to greater fire emissions and more frequent flow from Canada and subarctic during 2003 (and 2002).



CO-O3 correlations: 2001 and 2003

- Red: U.S. outflow events.
- Blue: Biomass burning events.
- Green: Either or both.

- d[O3]/d[CO] slope during U.S. outflow ~1.0, >> previous observations over east coast.
- Significant O3 enhancement during biomass burning events, even those from Siberia.



Plans for the future

- Measurements during fall 2004, spring 2005.
- Takedown summer 2005. (So far, Portuguese Met Institute not interested in taking it over.)

Acknowledgements

National Oceanic and Atmospheric Administration

Science and Technology Foundation (Portugal)

National Science Foundation

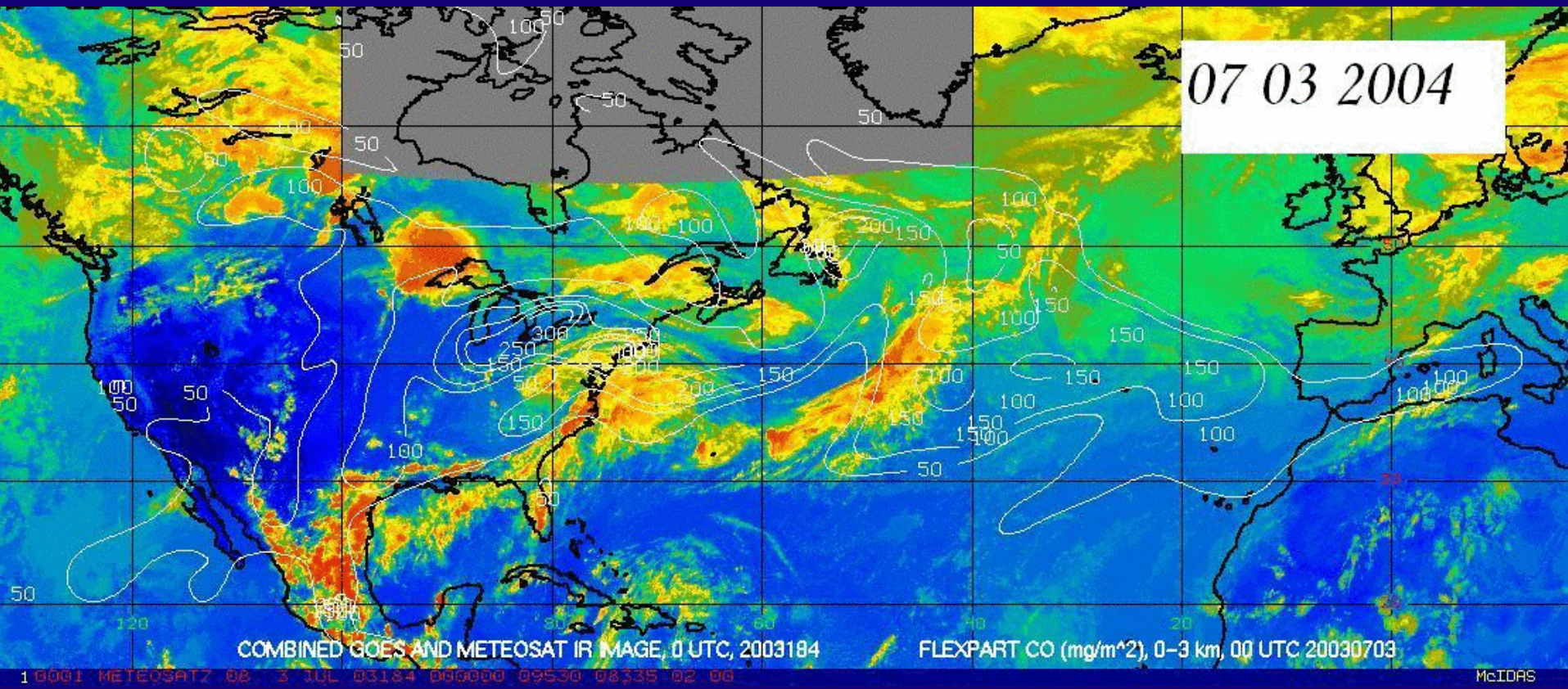
U.S. Air Force

More information:

http://www.cee.mtu.edu/~reh/pico/icartt (icartt password)

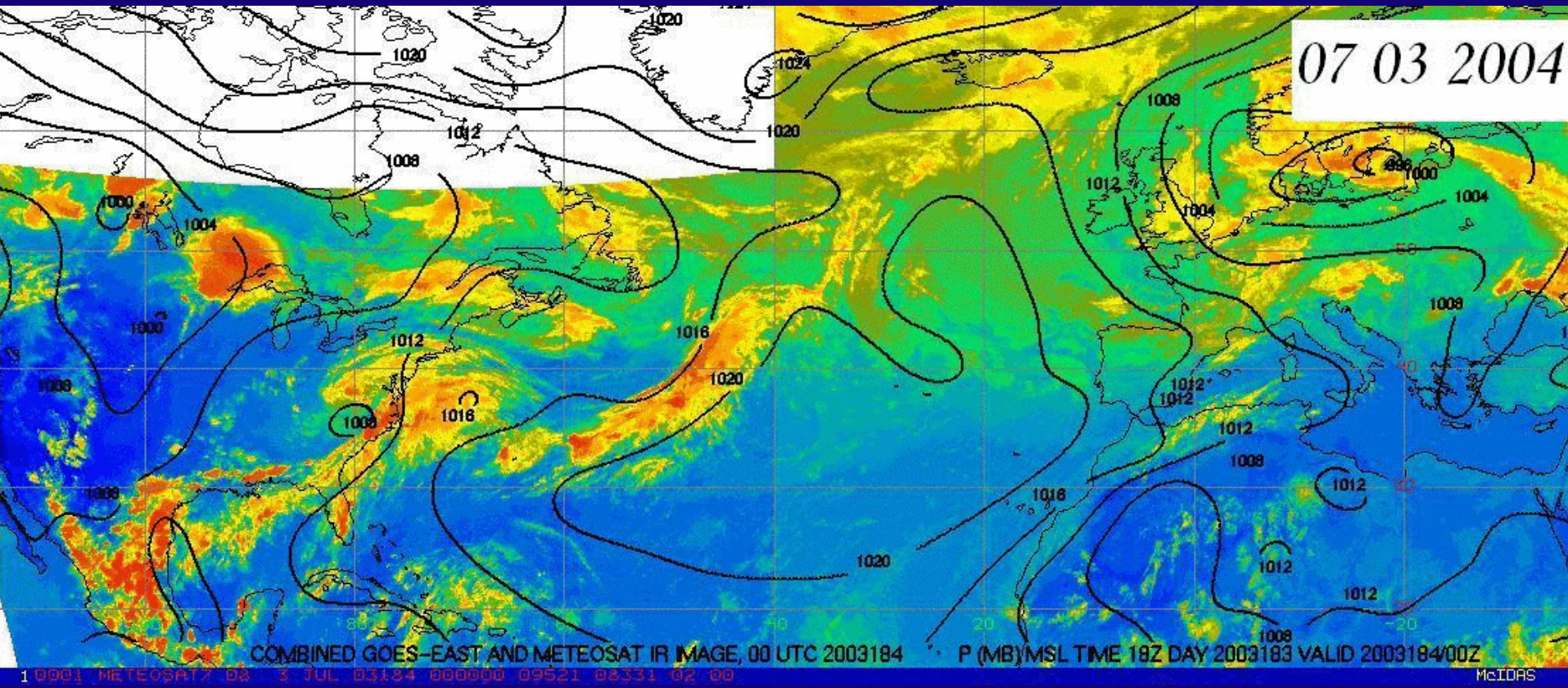
http://www.cee.mtu.edu/~reh/pico (public page)

4. HYSPLIT forward model



5. Sea-level Pressures during the event

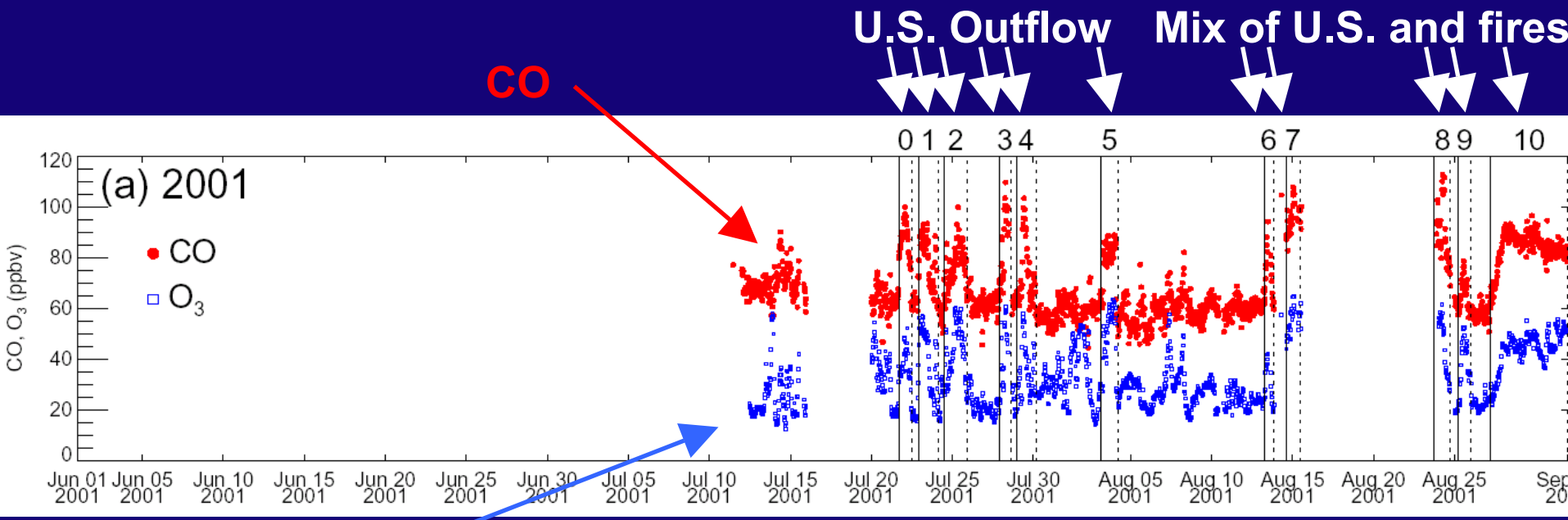
Flow occurs along upper edge of Azores high and south side of low. Reaches Azores as the high weakens or stretches.



View over cliff toward the Northwest

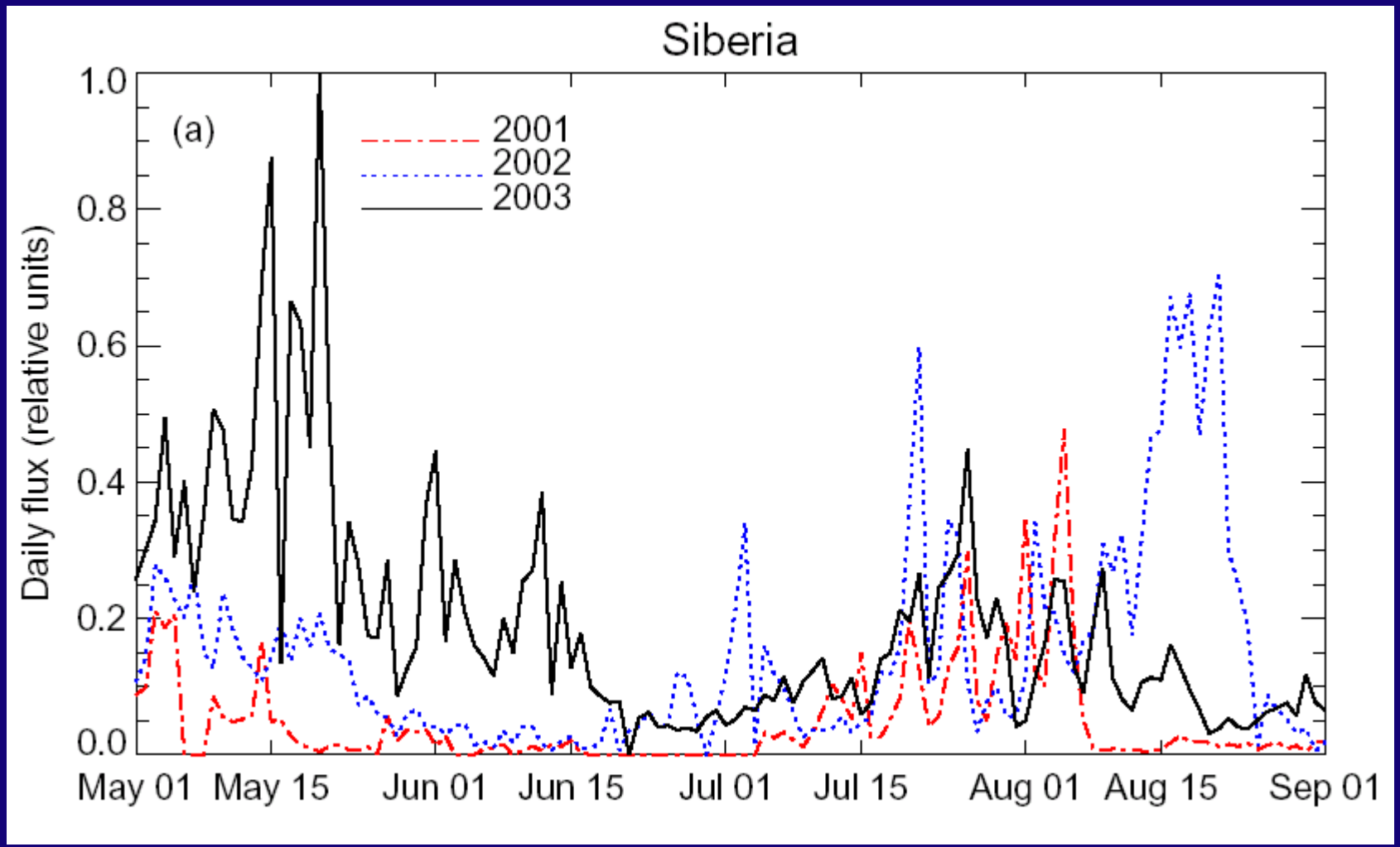
View toward ~West

U.S. Outflow was responsible for most high-CO periods in summer 2001



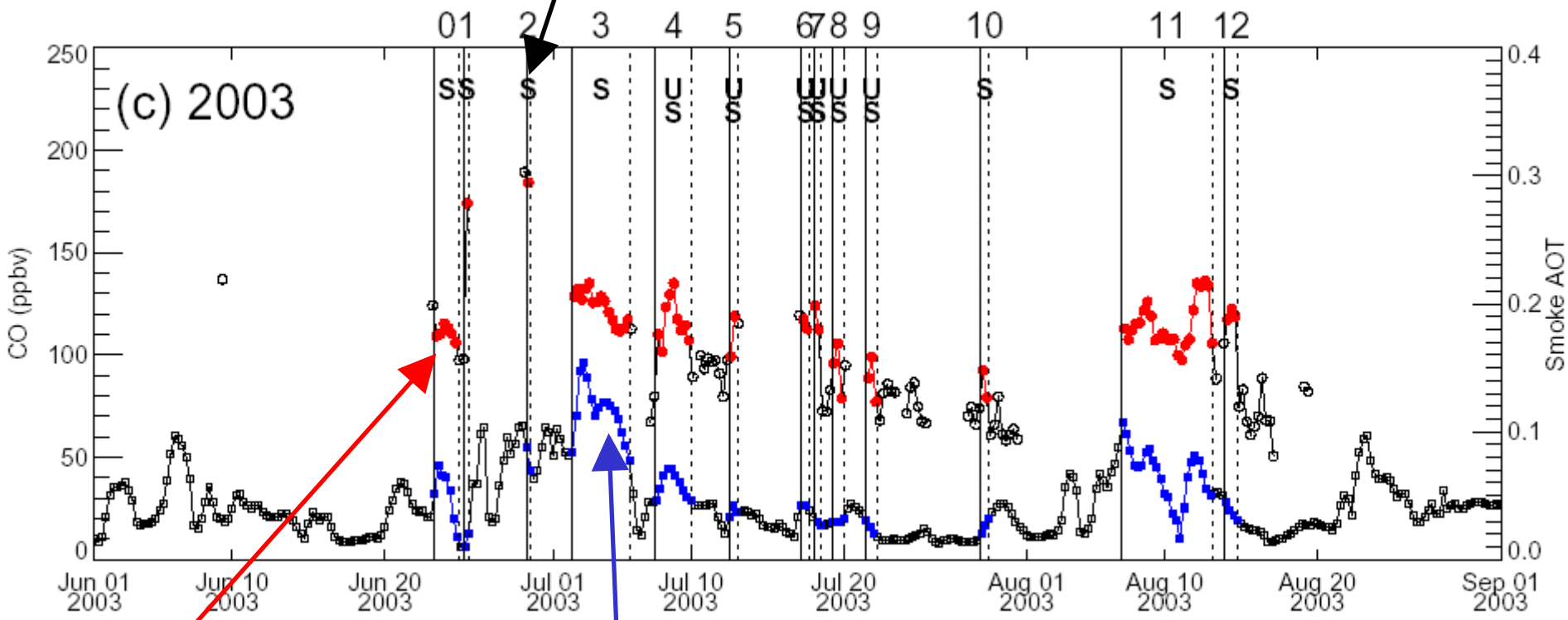
Ozone

Siberian fires impacted Pico
Interannual variability in Siberian fire emissions



CO enhancements during transport of Siberian and U.S. fire emissions during 2003

Location of fires responsible for AOT enhancement:
S=Siberia, US=United States



CO at Pico

AOT Over Azores, modeled by NAAPS using FLAMBE (GOES) and MODIS fire counts